LEUPOLD®

TACTICAL OPTICS

Using the Tactical Reticle System Mark 8™ CQBSS™

USAGE INSTRUCTIONS

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The Leupold® Tactical Milling Reticle (TMR®)

The Leupold® Tactical Milling Reticle (TMR®) and Horus H27 reticle employ a system based on the subtension of one milliradian (mil) from the center of one full hash mark to the center of the next full hash mark. This subtension also applies from the center of the reticle to the center of the first full hash mark in any direction.

The principle behind Leupold's TMR is to expand on existing mil dot reticle designs by offering users more ranging tools in the form of various sized and various spaced aiming points on the horizontal and vertical stadia. This allows greater ranging and shooting precision than all previous range estimating reticle systems. The TMR reticle subtends exactly like all existing mil dot reticles and generations thereof, but with greater accuracy. Aside from mil hash marks, the

TMR reticle offers areas of .2 mil subdivisions to precisely measure the common one meter target quickly from 500 to 1,000 meters and beyond. This has previously been the most difficult task in long-range shooting, since this entire range lies in the span between one and two mils. The position of the .2 mil subdivisions are intentionally placed on the periphery of the fine crosshair in order to keep the central area clutter free. All existing mil dot calculations and formula tools are compatible with the Leupold TMR design.

Products containing Horus reticles are produced under license from Horus Vision, LLC and protected by one or more of U.S. Patents 6,681,512, 6,453,595, 6,032,374, and 5,920,995; additional patents pending.

The Horus® H27 reticle is uniquely engineered to facilitate shooting at any number of unknown ranges without mechanical adjustment, Horus reticles are designed to easily solve many of the complex issues facing long range shooters. When properly utilized, Horus reticles can be used for range estimation, hold-over and windage correction, leading moving targets, second shot correction, and bracket snap shooting with both supersonic and subsonic ammunition.

All H27 reticle markings are calibrated in Mil-based increments, allowing for precise measurement to the nearest 1/10 Mil. When zeroing the H27, the main crosshair should be precisely zeroed to match the point of impact at 100 yards.

Parts of the Leupold TMR and Horus® H27 Reticles

A milliradian is a unit of measure derived from the degrees of a circle (in a 360 degree circle, there are 6,283.2 milliradians, or 17.45 milliradians per degree.) This means that a milliradian will subtend different amounts at different ranges. For example:

The subtension of 1 mil equals 3.6 inches (3.44 MOA) at 100 yards or 36 inches at 1,000 yards. In metric units, the correspondence is 1 mil equals 10 centimeters at 100 meters or 1 meter at 1,000 meters. Knowing this subtension and knowing the size of the target (or a reference object near the target) allows the distance to the target to be estimated with considerable accuracy.

The base scale for the TMR is .2 milliradians and the base scale for the H27 is .1 milliradians. The incremental milliradian values designated by various hash marks of the TMR are 5.0, 1.0, .50, .40, .20, .15, or .10 milliradians. The fine crosshair scale totals 10 milliradians per axis, with the addition of a 5 milliradian hash mark on each end post for a total of 20 milliradians per axis (TMR).

The scale can be visually subdivided and/or combined by a trained user to produce infinite milliradian reference combinations for limitless target ranging, leading, or holdover precision. Since the holdover features are presented in milliradian increments, they can be correlated to any ballistic trajectory or used to estimate windage and lead moving targets in the same manner as all milliradian based reticles.

To use the TMR or H27 simply determine the range to the target using the mil system, then use the corresponding aiming point that is matched to your cartridge to engage the target.

Leupold's TMR uses a mil dot style framework that incorporates a milliradian-based subtension scale for ranging known targets. In addition, the intersection of the crosshair is left open, creating a small, clear aperture for increased precision at longer ranges. Recent findings have determined that existing reticle designs obscure the target at longer distances. The TMR reticle eliminates that problem.

FIRST FOCAL PLANE RETICLES

All reticles in the Mark 8 CQBSS are located in the first/front focal plane providing accurate subtension values regardless of the magnification setting used.

THE USE OF A TMR OR H27 RETICLE

To use the TMR or H27 reticle, you must know the actual size of the target.

1. View the target through the scope.

2. Place the center of the crosshair against one edge (top, bottom, or either side) of the target so that the crosshair extends along either its width or height.

3. Using the hash marks, measure along the crosshair to the opposite edge of the target.

If the center of the crosshair is against one edge of the target and the opposite edge of the target is positioned behind the center of the second mil mark, the target measures 2 mils. If it is exactly between the second and third mil mark, it measures 2.5 mils, etc. The more specific you are in your estimation of the size of the target in mils (2.75 mils, etc.), the more accurate your results will be. This is especially important in estimating the range of a small target or in estimating the range of a target at a great distance (i.e. beyond 500 yards). Once the measurement of the target has been determined in mils, the range can be estimated. This can be done in two ways; either by consulting the charts in this manual or by using the following formula:

(Height of Target in Yards x 1,000) ÷ Height of Target in Mils = Range of the Target in Yards

This formula will also give results in metric terms if meters instead of yards are used in the equation.

For your convenience, Leupold has included range estimating tables (see Tables 1-8). To use these tables, locate the actual size of the target along the top of the table and the apparent size of the target, as measured in mils, along the side of the table. Follow both until they converge. This is the estimated distance to the target.

Using the Data Obtained With the Tactical Milling Reticle or H27

Once you have estimated the distance to the target with the reticle, there are two primary methods of using this information. Both require that you know the specific bullet drop of the ammunition you are using, measured in milliradians.

If your bullet drop has been measured in inches, a conversion to MOA will need to be applied using the formula below.

$$\frac{(\text{Bullet Drop in Inches} \div 1.047)}{\text{Target Distance in Hundreds of Yards/Meters}} = \text{Bullet Drop in MOA}$$

Once the bullet drop has been measured in MOA, use the formula below to convert MOA to mils:

$$\frac{\text{Bullet Drop in MOA}}{3.44} = \text{Bullet Drop in Mils}$$

Example 1: If you have a 500 yard/meter shot and you know your bullet drops 65 inches at that distance, you would follow the steps below:

Convert 65 inches to MOA:

$$\frac{(65" \div 1.047)}{5} = \frac{62}{5} = 12.4 \text{ MOA}$$

Convert MOA to mils:

$$\frac{12.4 \text{ MOA}}{3.44 \text{ MOA per mil}} = \text{Bullet drop in mils} = 3.6$$

This bullet would be dropping 3.6 mils at 500 yards.

Example 2: If your bullet drops 130 Inches at 650 yards/meters, the process would look like this:

$$\frac{(130" \div 1.047)}{6.5} = \frac{124}{6.5} = 19 \text{ MOA}$$

$$\frac{19 \text{ MOA}}{3.44 \text{ MOA per mil}} = \text{Bullet drop in mils} = 5.5$$

This bullet would be dropping 5.5 mils at 650 yards.

NOTE: *The numbers used in the calculations above have been rounded and are for explanation purposes only.*

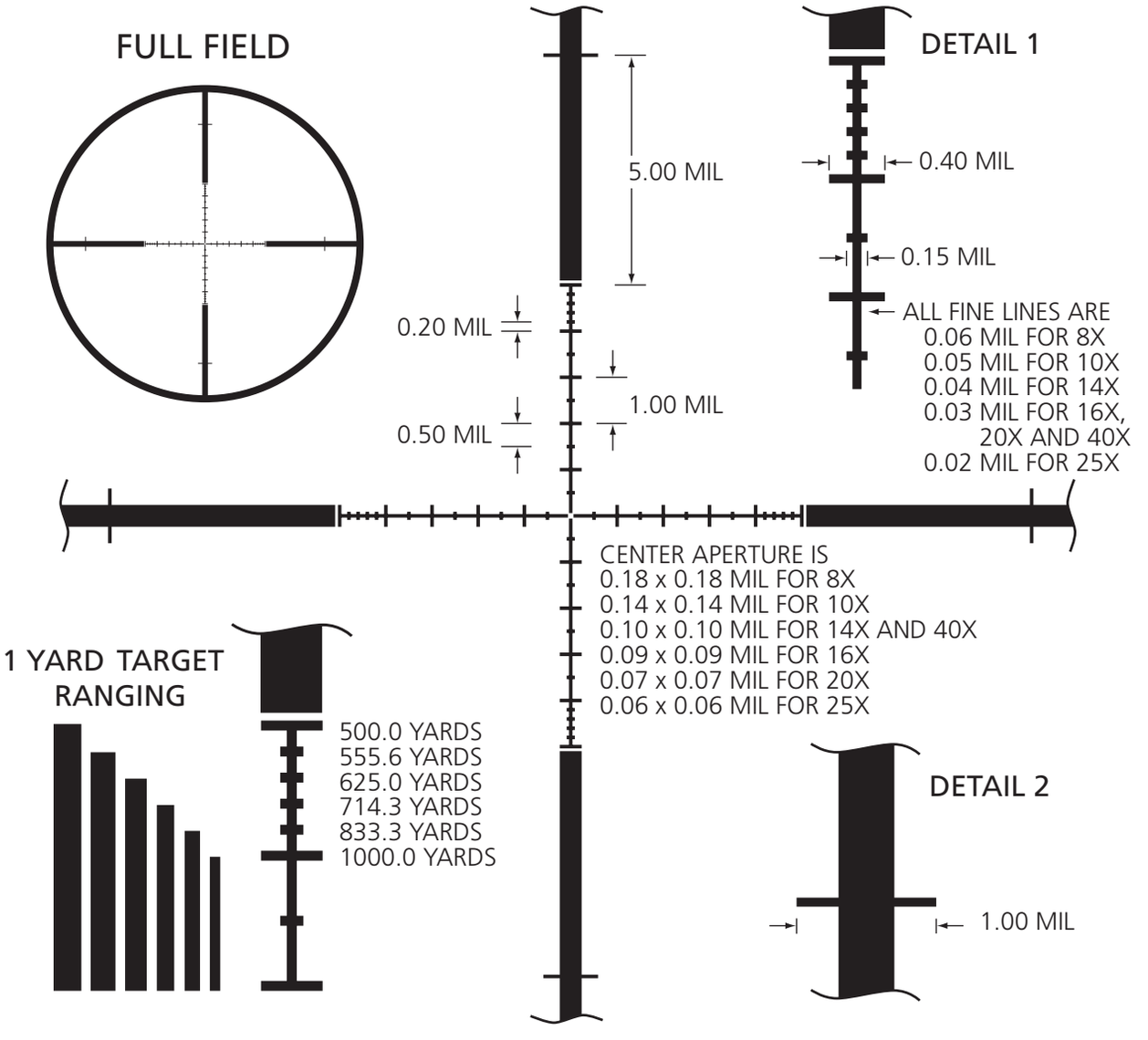
DIALING THE CORRECTION INTO THE SCOPE

The most effective way to use the estimated distance is to dial the necessary correction into the scope using the elevation adjustment. If your scope features a bullet drop compensation dial, simply dial the correction directly according to the distance marked on the elevation dial. If your scope does not have a bullet drop compensation dial and your bullet drop has been measured in milliradians, simply use the elevation adjustment to make the appropriate correction. For example, if you need to allow for a bullet drop of 2 mils, you will simply dial 2 mils (20 clicks) in the up direction.

HOLDING OVER USING THE H27 OR TACTICAL MILLING RETICLE

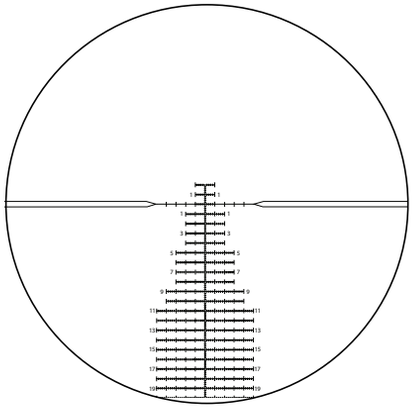
Sometimes there isn't time for correction using the scope's adjustment mechanisms. In these cases, holding over the target and using the reticle's markings as an aiming point is useful. It must be remembered that holding over is not as exact as dialing elevation.

TACTICAL MILLING RETICLE SUBTENSIONS

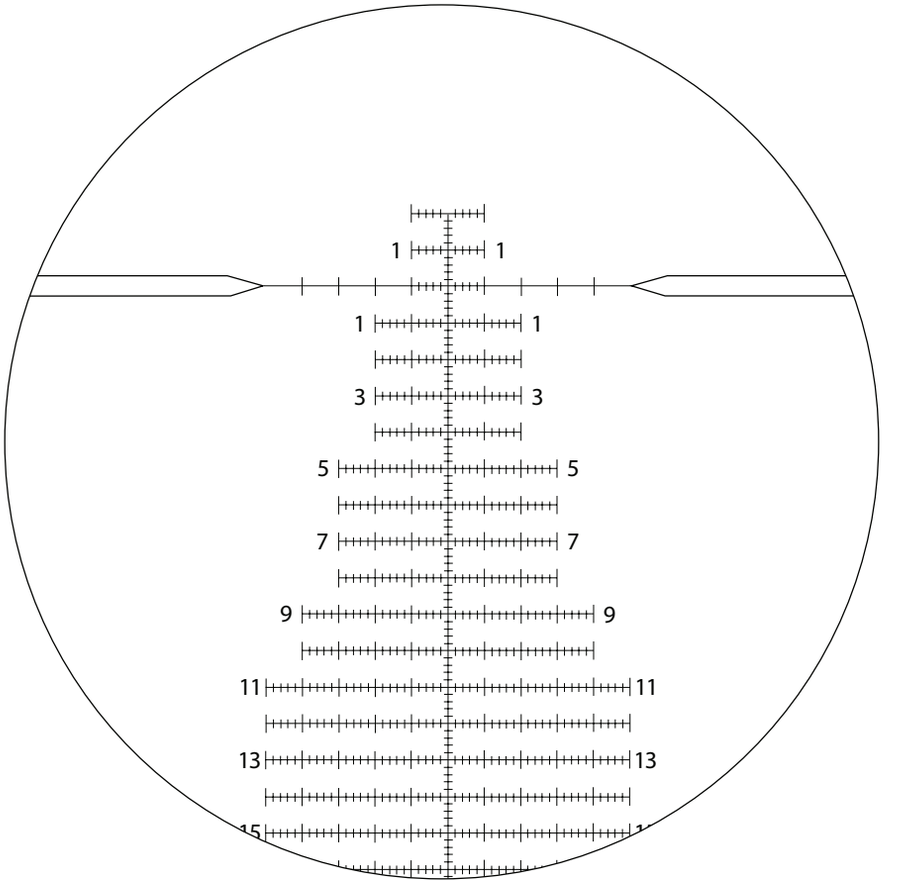


@100 Yards	5.0 mil = 18.000" 1.0 mil = 3.600" 0.5 mil = 1.800" 0.4 mil = 1.400"	0.20 mil = 0.720" 0.15 mil = 0.54" 0.10 mil = 0.360" 1.0 mil = 3.438 Minutes of Angle = 3.600"

HORUS H27 RETICLE SUBTENSIONS



DETAIL VIEW X
NON-ILLUMINATED



@100 Yards	5.0 mil = 18.000" 1.0 mil = 3.600" 0.5 mil = 1.800" 0.4 mil = 1.400"	0.20 mil = 0.720" 0.15 mil = 0.54" 0.10 mil = 0.360" 1.0 mil = 3.438 Minutes of Angle = 3.600"

YIELDS ESTIMATED TARGET DISTANCE IN YARDS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN INCHES OR YARDS								
	INCHES	9	12	16	18	20	22	24	28	32
	YARDS	0.250	0.333	0.444	0.500	0.556	0.611	0.667	0.778	0.889
	1.00 MIL	250	333	444	500	556	611	667	778	889
	1.25 MIL	200	267	356	400	444	489	533	622	711
	1.50 MIL	167	222	296	333	370	407	444	519	593
	1.75 MIL	143	190	254	286	317	349	381	444	508
	2.00 MIL	125	167	222	250	278	306	333	389	444

Table 1

YIELDS ESTIMATED TARGET DISTANCE IN YARDS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN INCHES OR YARDS								
	INCHES	9	12	16	18	20	22	24	28	32
	YARDS	0.250	0.333	0.444	0.500	0.556	0.611	0.667	0.778	0.889
	1.0 MIL	250	333	444	500	556	611	667	778	889
	1.5 MIL	167	222	296	333	370	407	444	519	593
	2.0 MIL	125	167	222	250	278	306	333	389	444
	2.5 MIL	100	133	178	200	222	244	267	311	356
	3.0 MIL	83	111	148	167	185	204	222	259	296
	3.5 MIL	71	95	127	143	159	175	190	222	254
	4.0 MIL	63	83	111	125	139	153	167	194	222
	4.5 MIL	56	74	99	111	123	136	148	173	198
	5.0 MIL	50	67	89	100	111	122	133	156	178
	5.5 MIL	45	61	81	91	101	111	121	141	162
	6.0 MIL	42	56	74	83	93	102	111	130	148
	6.5 MIL	38	51	68	77	85	94	103	120	137
	7.0 MIL	36	48	63	71	79	87	95	111	127
	7.5 MIL	33	44	59	67	74	81	89	104	119
	8.0 MIL	31	42	56	63	69	76	83	97	111
	8.5 MIL	29	39	52	59	65	72	78	92	105
	9.0 MIL	28	37	49	56	62	68	74	86	99
	9.5 MIL	26	35	47	53	58	64	70	82	94
	10.0 MIL	25	33	44	50	56	61	67	78	89

Table 2

YIELDS ESTIMATED TARGET DISTANCE IN YARDS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN FEET OR YARDS					
	FEET	3	4	5	6	7
	YARDS	1.0	1.3	1.7	2.0	2.3
	1.0 MIL	1,000	1,333	1,667	2,000	2,333
	1.5 MIL	667	889	1,111	1,333	1,556
	2.0 MIL	500	667	833	1,000	1,167
	2.5 MIL	400	533	667	800	933
	3.0 MIL	333	444	556	667	778
	3.5 MIL	286	381	476	571	667
	4.0 MIL	250	333	417	500	583
	4.5 MIL	222	296	370	444	519
	5.0 MIL	200	267	333	400	467
	5.5 MIL	182	242	303	364	424
	6.0 MIL	167	222	278	333	389
	6.5 MIL	154	205	256	308	359
	7.0 MIL	143	190	238	286	333
	7.5 MIL	133	178	222	267	311
	8.0 MIL	125	167	208	250	292
	8.5 MIL	118	157	196	235	275
	9.0 MIL	111	148	185	222	259
	9.5 MIL	105	140	175	211	246
	10.0 MIL	100	133	167	200	233

Table 3

YIELDS ESTIMATED TARGET DISTANCE IN METERS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN CENTIMETERS						
CENTIMETERS	30	40	50	60	70	80	90
1.00 MIL	300	400	500	600	700	800	900
1.25 MIL	240	320	400	480	560	640	720
1.50 MIL	200	267	333	400	467	533	600
1.75 MIL	171	229	286	343	400	457	514
2.00 MIL	150	200	250	300	350	400	450

Table 4

YIELDS ESTIMATED TARGET DISTANCE IN METERS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN CENTIMETERS							
	CENTIMETERS	30	40	50	60	70	80	90
	1.0 MIL	300	400	500	600	700	800	900
	1.5 MIL	200	267	333	400	467	533	600
	2.0 MIL	150	200	250	300	350	400	450
	2.5 MIL	120	160	200	240	280	320	360
	3.0 MIL	100	133	167	200	233	267	300
	3.5 MIL	86	114	143	171	200	229	257
	4.0 MIL	75	100	125	150	175	200	225
	4.5 MIL	67	89	111	133	156	178	200
	5.0 MIL	60	80	100	120	140	160	180
	5.5 MIL	55	73	91	109	127	145	164
	6.0 MIL	50	67	83	100	117	133	150
	6.5 MIL	46	62	77	92	108	123	138
	7.0 MIL	43	57	71	86	100	114	129
	7.5 MIL	40	53	67	80	93	107	120
	8.0 MIL	38	50	63	75	88	100	113
	8.5 MIL	35	47	59	71	82	94	106
	9.0 MIL	33	44	56	67	78	89	100
	9.5 MIL	32	42	53	63	74	84	95
	10.0 MIL	30	40	50	60	70	80	90

Table 5

YIELDS ESTIMATED TARGET DISTANCE IN METERS

APPARENT SIZE OF THE TARGET IN MILS	ACTUAL SIZE OF THE TARGET IN METERS					
	METERS	1.00	1.25	1.50	1.75	2.00
	1.00 MIL	1,000	1,250	1,500	1,750	2,000
	1.50 MIL	667	833	1,000	1,167	1,333
	2.0 MIL	500	625	750	875	1,000
	2.5 MIL	400	500	600	700	800
	3.0 MIL	333	417	500	583	667
	3.5 MIL	286	357	429	500	571
	4.0 MIL	250	313	375	438	500
	4.5 MIL	222	278	333	389	444
	5.0 MIL	200	250	300	350	400
	5.5 MIL	182	227	273	318	364
	6.0 MIL	167	208	250	292	333
	6.5 MIL	154	192	231	269	308
	7.0 MIL	143	179	214	250	286
	7.5 MIL	133	167	200	233	267
	8.0 MIL	125	156	188	219	250
	8.5 MIL	118	147	176	206	235
	9.0 MIL	111	139	167	194	222
	9.5 MIL	105	132	158	184	211
	10.0 MIL	100	125	150	175	200

Table 6

VALUE OF MILS IN INCHES AT DISTANCES MEASURED IN YARDS

MILS	DISTANCE TO THE TARGET IN YARDS								
	YARDS	100	150	200	250	300	350	400	450	500
	1.0 MIL	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0
	1.5 MIL	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.0
	2.0 MIL	7.2	10.8	14.4	18.0	21.6	25.2	28.8	32.4	36.0
	2.5 MIL	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5	45.0
	3.0 MIL	10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6	54.0
	3.5 MIL	12.6	18.9	25.2	31.5	37.8	44.1	50.4	56.7	63.0
	4.0 MIL	14.4	21.6	28.8	36.0	43.2	50.4	57.6	64.8	72.0
	4.5 MIL	16.2	24.3	32.4	40.5	48.6	56.7	64.8	72.9	81.0
	5.0 MIL	18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0	90.0

Table 7

VALUE OF MILS IN CENTIMETERS AT DISTANCES MEASURED IN METERS

MILS	DISTANCE TO THE TARGET IN METERS								
	METERS	100	150	200	250	300	350	400	450	500
	1.0 MIL	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
	1.5 MIL	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5	75.0
	2.0 MI	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
	2.5 MIL	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5	125.0
	3.0 MIL	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0
	3.5 MIL	35.0	52.5	70.0	87.5	105.0	122.5	140.0	157.5	175.0
	4.0 MIL	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0
	4.5 MIL	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5	225.0
	5.0 MIL	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0	250.0

Table 8

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